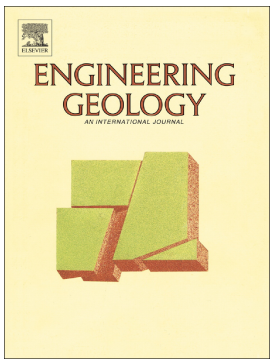

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The 2009 Jiweishan rock avalanche, Wulong, China: precursor conditions and factors leading to failure

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Abstract

This study investigates the predisposing geological and anthropogenic factors and indicative precursors preceding the fatal 5 June 2009 Jiweishan rock avalanche. It began as a rockslide and transformed into a rock avalanche that killed 74 people and caused major property loss due to misdiagnosis of the failure mode, and underestimation of volume and travel distance. Besides topography, structure and stratigraphy that favoured failure, mining below the failed rock mass had changed the state of stress and altered groundwater flow. The anthropogenic factors caused deformation and accelerated failure of the slope, and therefore were important contributions. Cracks and a karstic zone had developed along regional joints and defined several boundaries of the failed rock mass. Furthermore, a 2-m-wide crack developed since 1958 revealed a potential basal failure surface at the contact between karstic limestone and an underlying pre-sheared thin shale aquiclude. Increasing magnitude and frequency of rockfalls and tension cracks at the front end of the sliding block appeared three days before the event and implied the likely movement direction of the sliding rock mass. These could have warned of a developing giant failure. Topography included a large elevation difference between the toe of the failure surface and the cliff base, a narrow valley to channel debris, and the steep gradient of